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ate in Africa, South Asia and Australia is characterized by Mesozoic types. This change is believed by many to have been brought about by the cold climate which was the determining cause of the conglomerate beds. Blanford and Waagen go further and connect the decline of the marine Paleozoic types with the cold climate of the end of the Paleozoic.

In the discussion of the Mesozoic and Neozoic there is scarcely any reference to American geology. In connection with the discussion of Pleistocene geology, two glacial epochs are recognized. The author inclines to the eolian hypothesis for the origin of loess.

Both the physical and paleontological phases of the subjects discussed in the volume are illustrated by numerous figures, the former rather less fully than the latter. A series of maps, showing the distribution and relations of the systems described, would have enhanced the value of the volume which is still great without them.

ROLLIN D. SALISBURY.

Iowa Geological Survey. Vol. I. First Annual Report, 1892. SAMUEL CALVIN, State Geologist, Des Moines, 1893. 8vo, 472 pp., 10 plates and 26 figures.

IN addition to brief administrative reports, the first report of Iowa's third survey contains papers by S. Calvin, C. R. Keyes, Assistant State Geologist, S. W. Beyer, H. F. Bain and G. L. Houser.

The introductory paper by Mr. Keyes, on the Geological Formations of Iowa, is a summary of present knowledge of the various formations occurring within the limits of the state. The writer has availed himself of the various studies made of these rocks in recent years, and the result is shown in an improved classification over that of preceding surveys. While all the formations have come under careful study, the most notable progress is shown to have been made in the classification of the Devonian, the Carboniferous and the Cretaceous.

Investigations in northwestern Iowa have brought to light the presence of undoubted eruptive rocks at no great depth below the surface. In Mr. Beyer's paper are given the details relating to the discovery of typical quartz-prophyry, interbedded with sandstone and gravel, in a deep well at Hull, Iowa. The discovery by Culver and Hobbs of eruptive rock within the Sioux quartzite in southeastern

Dakota is referred to, and, following Hall, White, and Irving, the conclusion is drawn that the Sioux quartzite is the oldest formation in the state. Some familiar names have disappeared from the geological section, and their places are assumed by newer but more appropriate terms, as, for example, Oneota for Lower Magnesian, St. Croix for Potsdam, while Hamilton is represented by four names applied to as many subdivisions. The term Augusta is given to the terranes including the Warsaw, Keokuk and Burlington, in place of William's term Osage which is discarded as inapplicable. The Warsaw beds of Hall are here included with the Keokuk, and the term Warsaw dropped. An error occurs in the definition of the St. Louis limestone on page 72, where it is asserted that the brecciated limestone constitutes the base of the beds in Iowa. This is the case only along the extreme margin of the beds. Seaward from the old shore line, as shown along the Des Moines in Van Buren county, the basal member consists of a brown, magnesian limestone in fairly regular, more or less undulating beds. The texture is sometimes nodular and sandy. In thickness the formation varies from five to fifteen feet or more.

The structure of the coal measures is treated in considerable detail, and emphasis is given to conclusions based largely upon Mr. Keyes' investigations in Iowa. These rocks are included in two stages, the lower or Des Moines, and the upper or Missouri formation, White's middle division being discarded. These are not considered two distinct formations in the sense that the lower was deposited prior to the laying down of the upper—the view commonly entertained—but the two were formed contemporaneously, the former as a marginal or shore formation, and the latter as its deep or open sea correlative. The view here advanced seems to be a modification of that held by Winslow. The conditions of deposition were evidently those of a slowly sinking shore, and the marginal deposits practically underlie the open sea formation though not necessarily much older ; hence the terms lower and upper are retained, though emphasis is given to their general contemporaneity. The summary of Professor Calvin's researches on the Devonian and Cretaceous rocks shows a marked advance in the knowledge of these formations.

The classification of Iowa rocks, given by the different surveys, is here presented for comparison :

HALL'S REPORT, 1858.	WHITE'S REPORT, 1870.	CALVIN & KEYES REPORT, 1892.
Quaternary. { Alluvium. Drift.	Post Tertiary. { Alluvium. Bluff. Drift. { Altered.	Quaternary. { Alluvium. Loess. Drift. { Upper till. Lower till.
Cretaceous. { Presence in Iowa asserted, but rocks not described. Given on Owen's authority.	Lower Cretaceous. { Inoceramus beds. Woodbury sandstone and shale. Nishnabotna sandstone.	Upper Cretaceous. { Niobrara. { Inoceramus and possibly gypsum beds, and Nishnabotna sandstone. Fort Benton. } Dakota. } { Woodbury shale, and possibly the Nishnabotna sandstone
Permian ?—Gypsum beds.		
Carboniferous. { Coal Measures. Carboniferous limestone. { Kaskaskia (not present). Ferruginous sandstone (not present). St. Louis limestone. Warsaw. Keokuk. Burlington.	Carboniferous. { Coal Measures. { Upper. Middle. Lower. Sub-Carboniferous. { Chester (not present). St. Louis. Keokuk. Burlington. Kinderhook.	Carbonoiferus. { Upper Carboniferous or Pennsylvania Series. { Missouri Stage. Des Moines Stage. Lower Carboniferous or Mississippian. { Kaskaskia (or Chester) (not present). St. Louis. Augusta { Keokuk. Burlington. Kinderhook. { Chouteau lm. Hannibal sh. Louisiana lm.
Devonian. { Chemung group. Hamilton group. Upper Helderberg limestone.	Devonian—Hamilton limestone and shale.	Devonian. { Lime Creek shale. Montpelier sandstone. Cedar Valley limestone. Independence shale.
Upper Silurian. { Le Claire limestone. Niagara limestone.	Upper Silurian—Niagara limestone.	Upper Silurian. { Le Claire limestone. Niagara limestone.
Lower Silurian. { Hudson River group. Galena limestone. Trenton limestone. Black River and Birdseye limestone. St. Peter's sandstone. Calciferous sandstone. Potsdam sandstone.	Lower Silurian. { Maquoketa. Galena. Trenton. St. Peters. Lower Magnesian. Potsdam.	Lower Silurian. { Maquoketa. Galena. Trenton. St. Peters. Oneota.
		Upper Cambrian—St. Croix.
Huronian—Sioux Quartzite—1866.	Huronian?—Sioux quartzite.	Algonkian—Sioux quartzite.

Other papers by Mr. Keyes are: "Annotated Catalogue of Minerals," and "Bibliography of Iowa Geology."

Professor Calvin's paper is devoted to the Cretaceous deposits of Plymouth and Woodbury counties. In the region studied these beds are found to be sharply divisible lithologically into two divisions, a lower consisting of soft sandstones, with bands of hard ferruginous concretionary nodules, and variegated, often parti-colored clays, the latter greatly predominating and resting upon these a white or yellowish chalk, somewhat indurated in places into a soft fissile limestone. The first is White's Woodbury sandstones and shales, and the second is his Inoceramus beds. Following Meek and Hayden, Professor Calvin makes a threefold division of the beds, by drawing a somewhat arbitrary line about forty feet below the base of the Inoceramus beds. The lowest division contains impressions of leaves and a meagre brackish water fauna. This he correlates with the Dakota group. The second or middle division of dark colored calcareous shales, containing marine mollusks, associated with the vertebræ and teeth of bony fishes, and the skeletons of marine saurians, is the Fort Benton group of Meek and Hayden. The upper or Inoceramus beds represent the Niobrara of the same authors. During this epoch the Cretaceous sea had its farthest eastward extension, probably reaching as far as the Mississippi river in northeastern Iowa.

Mr. Beyer's paper is entitled Ancient Lava Flows in the Strata of Northwestern Iowa, and relates to the discovery in a well at Hull, Sioux county, of typical quartz porphyry at a depth of 755 feet. Microscopical study shows it to have a pronounced flow structure, while the quartz crystals show the effects of magmatic corrosion, and, in some cases, fracturing with discordant orientation of the fragments, from which it is inferred that the magma was semi-viscous and under great pressure when the flow took place. In the drilling, the eruptive rock was found to alternate with sandy strata, showing evidence of metamorphism down to 1,200 feet. Two hypotheses are advanced to account for the flows: (1) That they took place in Paleozoic times, perhaps Carboniferous, the lava being periodically poured out over the old sea bottoms; and (2) that the whole series of flows was contemporaneous, and in point of time post-Carboniferous. In this case the intercalations may be regarded as intrusive sheets, following the lines of least resistance and forcing themselves between the strata. Most probability seems to attach to the latter view.

Mr. Bain's paper deals with the distribution and relations of the St. Louis limestone in Mahaska county, where it is shown to have the same irregularity as to thickness and structure as it presents generally in Iowa. To explain the irregularity in the surface of this formation, appeal is made to erosion during Kaskaskia time, when Iowa was a land surface. This would imply a considerable elevation in order to produce the carving, a conclusion not wholly free from doubt. In some localities a sandstone, treated as presumably belonging to the coal measures, rests upon the limestone.

The remaining paper, by Mr. Houser, is devoted to a discussion of some lime-burning dolomites, and dolomitic building stones from the Niagara.

C. H. GORDON.